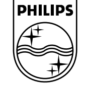
DATA SHEET

TEA5591
AM/FM radio receiver circuit

Product specification
File under Integrated Circuits, IC01

June 1989

Philips
Semiconductors





GENERAL DESCRIPTION

The TEA5591 is an integrated radio circuit which is designed for use in portable receivers and clock radios. The IC is also applicable to mains-fed AM an AM/FM receivers and car radio-receivers. The main advantage of this IC is its ability to operate over a wide range of supply voltages without loss of performance. The AM circuit incorporates a balanced mixer and a ‘one-pin’ oscillator, which operates in the 0.6 MHz to 30 MHz frequency range, with amplitude control. The circuit also includes an IF amplifier, a detector and an AGC circuit which controls the IF amplifier and the mixer. The FM circuit incorporates an RF amplifier, a balanced mixer and a ‘one-pin’ oscillator together with two AC coupled IF amplifiers (with distributed selectivity), a quadrature demodulator for the ceramic filter and internal AFC.

Features

- DC AM/FM switch facility
- Three internal separate stabilizers to enable operation over a wide range of supply voltages (1.8 to 15 V)
- All pins (except pin 9) are ESD protected.

QUICK REFERENCE DATA

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage (pin 8)		V_P	1.8	3.0	15	V
Supply current						
AM part		I_P(AM)	–	14	19	mA
FM part		I_P(FM)	–	17	23	mA
Operating ambient temperature range		T_{amb}	–15	–	+60	°C
AM performance (pin 13)	m = 0.3					
RF sensitivity						
RF input voltage	V_o = 10 mV	V_i	–	3.5	–	µ V
RF input voltage	(S+N)/N = 26 dB	V_i	–	17	–	µV
Signal plus noise-to-noise ratio	V_i = 1 mV	(S+N)/N	–	48	–	dB
AF output voltage		V_o	–	50	–	mV
Total harmonic distortion		THD	–	0.7	–	%
FM performance (pin 1)	Δf = 22.5 kHz					
RF sensitivity						
RF input voltage						
–3 dB before limiting		V_i	–	2.3	4.0	µV
Signal plus noise-to-noise ratio for:						
RF input signal voltage (V_i)	V_i = 3.0 µV	(S+N)/N	23	26	–	dB
	V_i = 1 mV	(S+N)/N	–	60	–	dB
AF output voltage	V_i = 100 µV	V_o	75	90	–	mV
Total harmonic distortion		THD	–	0.8	–	%

PACKAGE OUTLINE

20-lead DIL; plastic (SOT146); SOT146-1; 1996 August 14.

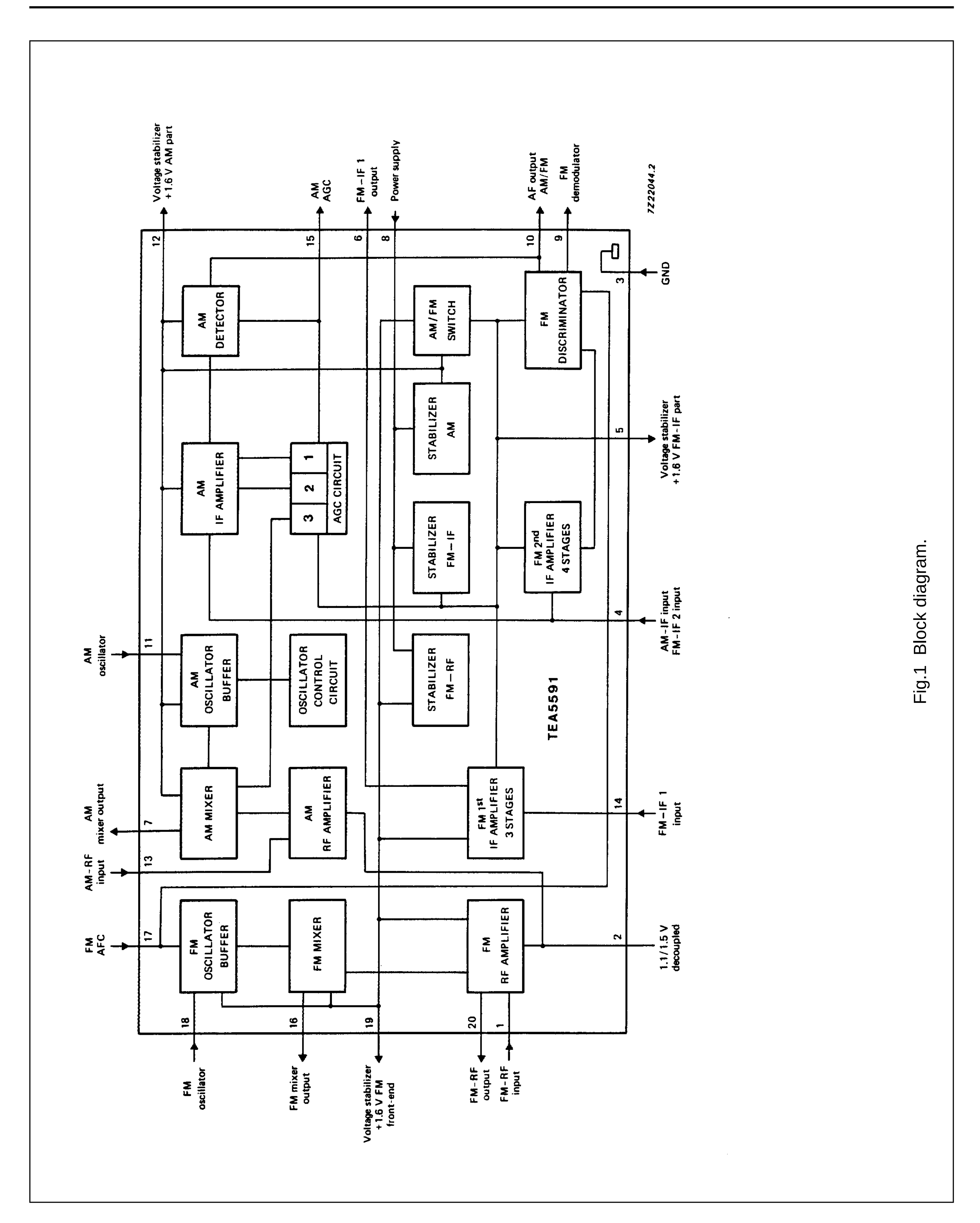


Fig.1 Block diagram.

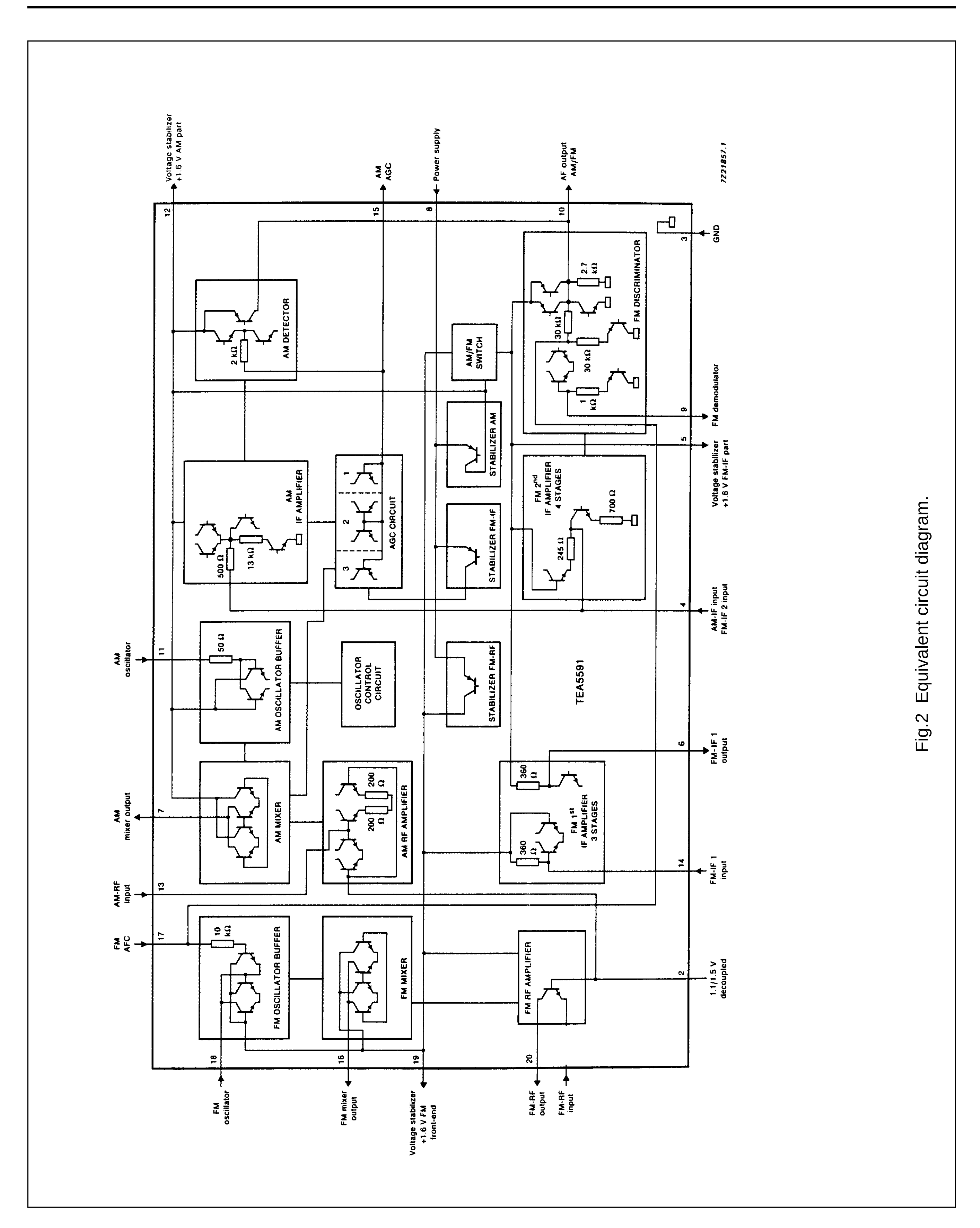


Fig.2 Equivalent circuit diagram.

PINNING

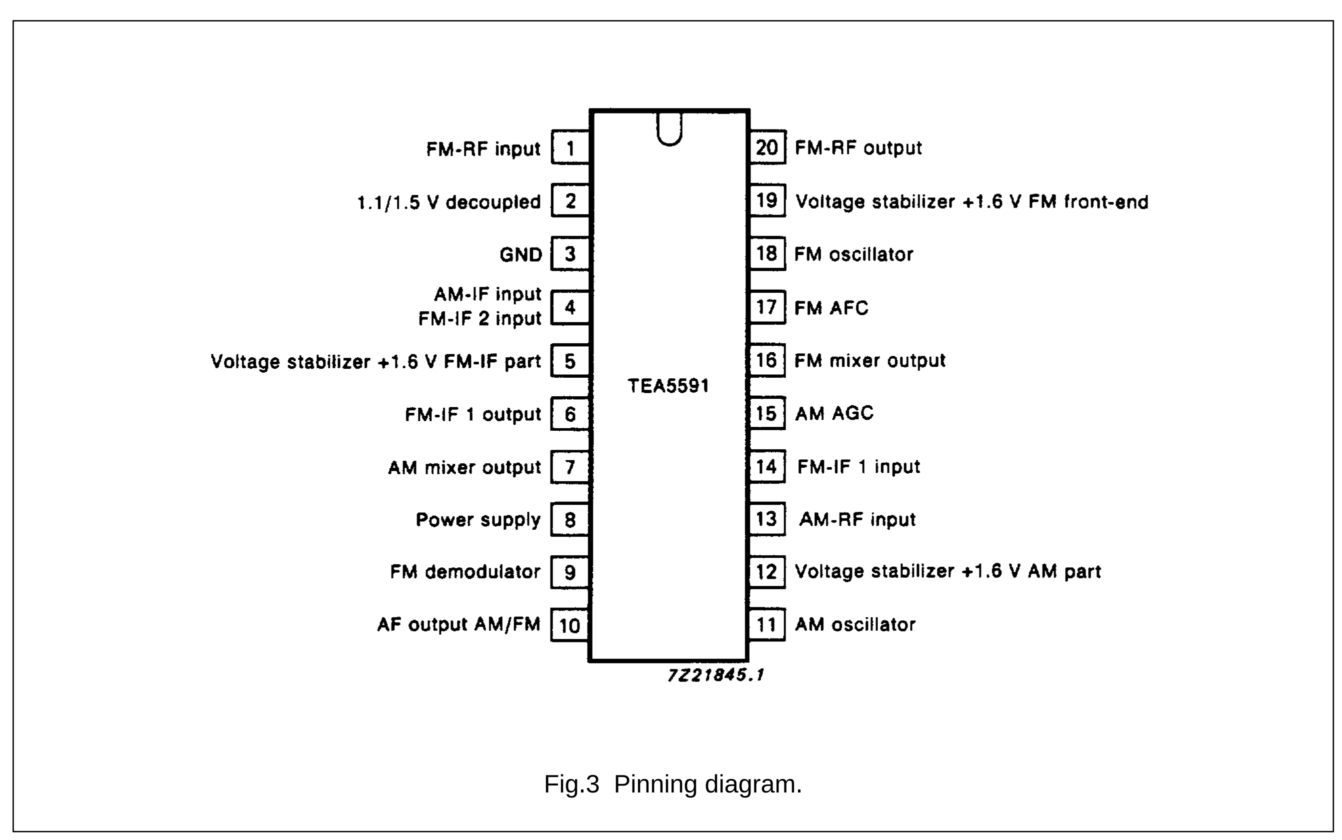


Fig.3 Pinning diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

PARAMETER	CONDITIONS	SYMBOL	MIN.	MAX.	UNIT
Supply voltage (pin 8)		V_P	–	18	V
Storage temperature range		T_{stg}	–65	+ 150	°C
Operating ambient temperature range		T_{amb}	–15	+ 60	°C
Total power dissipation		P_{tot}	see Fig.4		

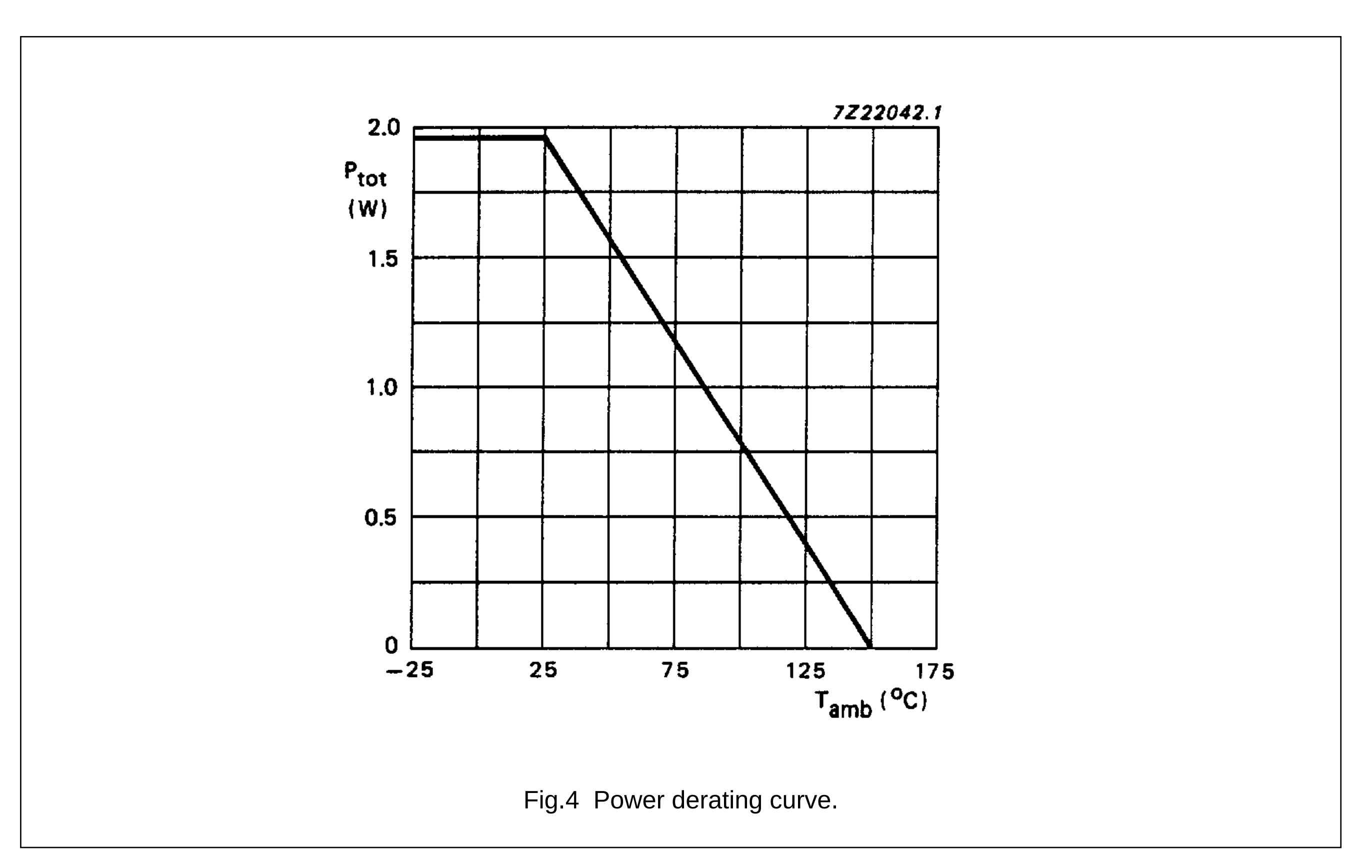


Fig.4 Power derating curve.

DC CHARACTERISTICS

All voltages are referenced to pin 3; all input currents are positive; all parameters are measured in Fig.5 at nominal supply voltage V_P = 3 V; T_{amb} = 25 °C unless otherwise specified

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage		V_P	1.8	3.0	15	V
Voltages (FM)						
pin 1		V_1	–	0.90	–	V
pin 2		V_2	–	1.60	–	V
pin 4		V_4	–	0.85	–	V
pin 5		V_5	1.5	1.60	1.75	V
pin 6		V_6	–	1.48	–	V
pin 9		V_9	–	1.05	–	V
pin 14		V_{14}	–	1.63	–	V
pin 17		V_{17}	–	0.60	–	V
pin 19		V_{19}	–	1.60	–	V
Voltages (AM)						
pin 2		V_2	–	1.10	–	V
pin 12		V_{12}	–	1.60	–	V
pin 15		V_{15}	–	1.54	–	V
Supply current						
AM part		$I_{P(AM)}$	–	14	19	mA
FM part		$I_{P(FM)}$	–	17	23	mA

AC CHARACTERISTICS

V_P = 3 V; T_{amb} = 25 °C unless otherwise specified

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
AM PART						
Input conductance pin 4	f = 0.5 MHz	g_{ie}	–	1.7	–	ms
Input capacitance pin 4	f = 0.5 MHz	C_{ie}	–	5	–	pF
Input conductance pin 13	f = 1.0 MHz	g_{ie}	–	230	–	µs
Input capacitance pin 13	f = 1.0 MHz	C_{ie}	–	13	–	pF
Output conductance pin 7	f = 0.5 MHz	g_{oe}	–	4	–	µs
Output capacitance pin 7	f = 0.5 MHz	C_{oe}	–	4.7	–	pF
Conductance pin 11	f = 1.5 MHz	g_e	–	–6.8	–	ms
Capacitance pin 11	f = 1.5 MHz	C_e	–	25	–	pF
FM PART						
Input conductance pin 4	f = 10.7 MHz	g_{ie}	–	2.7	–	ms
Input capacitance pin 4	f = 10.7 MHz	C_{ie}	–	6	–	pF
Input conductance pin 14	f = 10.7 MHz	g_{ie}	–	2.8	–	ms
Input capacitance pin 14	f = 10.7 MHz	C_{ie}	–	2.5	–	pF
Output conductance pin 6	f = 10.7 MHz	g_{oe}	–	2.8	–	ms
Output capacitance pin 6	f = 10.7 MHz	C_{oe}	–	3.0	–	pF
Output conductance pin 16	f = 10.7 MHz	g_{oe}	–	1.6	–	µs
Output capacitance pin 16	f = 10.7 MHz	C_{oe}	–	4.5	–	pF
Conductance pin 9	f = 10.7 MHz	g_e	–	880	–	µs
Capacitance pin 9	f = 10.7 MHz	C_e	–	3.6	–	pF
Conductance pin 18	f = 100 MHz	g_e	–	–4	–	ms
Capacitance pin 18	f = 100 MHz	C_e	–	10	–	pF

AC CHARACTERISTICS

All parameters are measured in Fig.5 at nominal supply voltage V_P = 3 V; T_{amb} = 25 °C unless otherwise specified.
RF conditions: Input frequency 1 MHz; 30% modulation where f_{mod} = 1 kHz; unless otherwise specified

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
AM PERFORMANCE						
RF sensitivity						
AF output voltage for:						
V_i = 7.5 µV	no AGC	V_o	16	30	40	mV
Noise						
Signal plus noise-to-noise ratio for:						
RF input signal voltage of						
V_i = 17 µV		(S + N)/N	23	26	–	dB
V_i = 1 mV		(S + N)/N	–	48	–	dB
Optimum source impedance		Z_S	–	1.8	–	kΩ
Noise factor	optimum noise impedance	NF	–	4	–	dB
AGC						
Change in RF input voltage for 10 dB change in output voltage	V_{i1} = 100 mV	V_{i1}/V_{i2}	80	86	–	dB
AF output voltage	V_i = 100 µV	V_o	40	50	60	mV
Total harmonic distortion	V_i = 100 µV to 10 mV	THD	–	0.7	1.5	%
	V_i = 100 µV to 10 mV; m = 0.8	THD	–	3	5	%
	V_i = 80 mV; m = 0.8	THD	–	–	8	%

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
IF suppression						
(note 1)	V_o = 30 mV	α	–	20	–	dB
Oscillator (pin 11)						
Input voltage	f_{osc} = 1.5 MHz	V_{osc}	–	150	190	mV
	f_{osc} = 30.5 MHz	V_{osc}	–	150	–	mV
	V_P = 1.5 V	V_{osc}	100	–	–	mV
Temperature behaviour	–15 to + 60 °C					
	(only the IC)					
Sensitivity		ΔV_i	–	–2	–	dB
Output voltage	V_i = 1 mV	ΔV_o	–	1	–	dB
Oscillator frequency						
LW		Δf_{osc}	–	500	–	Hz
MW		Δf_{osc}	–	300	–	Hz
SW		Δf_{osc}	–	100	–	kHz
Supply voltage behaviour	V_P = 1.8 to 15 V					
Sensitivity		ΔV_i	–	0	–	dB
Output voltage	V_i = 1 mV	ΔV_o	–	0.5	–	dB
Oscillator frequency						
LW		Δf_{osc}	–	6	–	kHz
MW		Δf_{osc}	–	0.1	–	kHz
SW		Δf_{osc}	–	30	–	kHz

Transimpedance (Z_{tr}) = V_4/i_7 = 900Ω.

AC CHARACTERISTICS

All parameters are measured in Fig.5 at nominal supply voltage V_P = 3 V; T_{amb} = 25 °C unless otherwise specified
RF conditions: Input frequency 100 MHz; frequency deviation f = ± 22,5 kHz and f_{mod} = 1 kHz

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
FM PERFORMANCE						
RF sensitivity						
RF input voltage	–3 dB before limiting	V_{iFM}	–	2.3	4.0	μV
Noise						
Signal plus noise-to-noise ratio for:						
RF input signal voltage (V_i)						
V_i = 3.0 μV		(S + N)/N	23	26	–	dB
V_i = 1 mV		(S + N)/N	–	60	–	dB
Optimum source impedance		Z_{source}	–	50	–	Ω
Noise factor	optimum noise impedance	NF	–	6	–	dB
AF output voltage	V_i = 100 μV	V_o	75	90	–	mV
Total harmonic distortion	V_i = 30 μV to 50 mV	THD	–	0.8	–	%
	V_i = 1 mV; Δf = 75 kHz	THD	–	3	–	%
	V_i = 100 mV; Δf = 75 kHz	THD	–	3	–	%
AM suppression	note 2					
RF input signal	V_i = 100 μV to 10 mV	AMS	–	50	–	dB
Oscillator voltage (pin 18)	f_{osc} = 100 MHz	V_{osc}	–	220	–	mV
	V_P = 1.5 V	V_{osc}	100	–	–	mV
IF rejection ratio		IF_{rr}	–	60	–	dB
AFC	f_{osc} = 111.2 MHz					
	V_{17} = 1.4 V	Δf	–	–620	–	kHz
	V_{17} = 0.2 V	Δf	–	+420	–	kHz

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Temperature behaviour	–15 to + 60 °C (only the IC)					
RF sensitivity	–3 dB limiting	ΔV_i	–	–6	–	dB
Output voltage	V_i = 100 µV	ΔV_o	–	–2	–	dB
Oscillator frequency		Δf_{osc}	–	–0.3	–	%
Supply voltage behaviour	V_P = 1.8 to 15 V					
RF sensitivity	–3 dB limiting	ΔV_i	–	6	–	dB
Output voltage	V_i = 100 µV	ΔV_o	–	0.5	–	dB
Oscillator frequency		Δf_{osc}	–	100	–	kHz
Oscillator voltage		ΔV_{osc}	–	1.0	–	dB

Notes to the AC characteristics

1. $\alpha = \frac{V_i \text{ at } f_i = 455 \text{ kHz}}{V_i \text{ at } f_i = 1 \text{ MHz}}$.
2. AM suppression is measured at:
   f_{mod} = 400 Hz, m = 0.3 for AM;
   f_{mod} = 1 kHz, Δf = 75 kHz for FM.

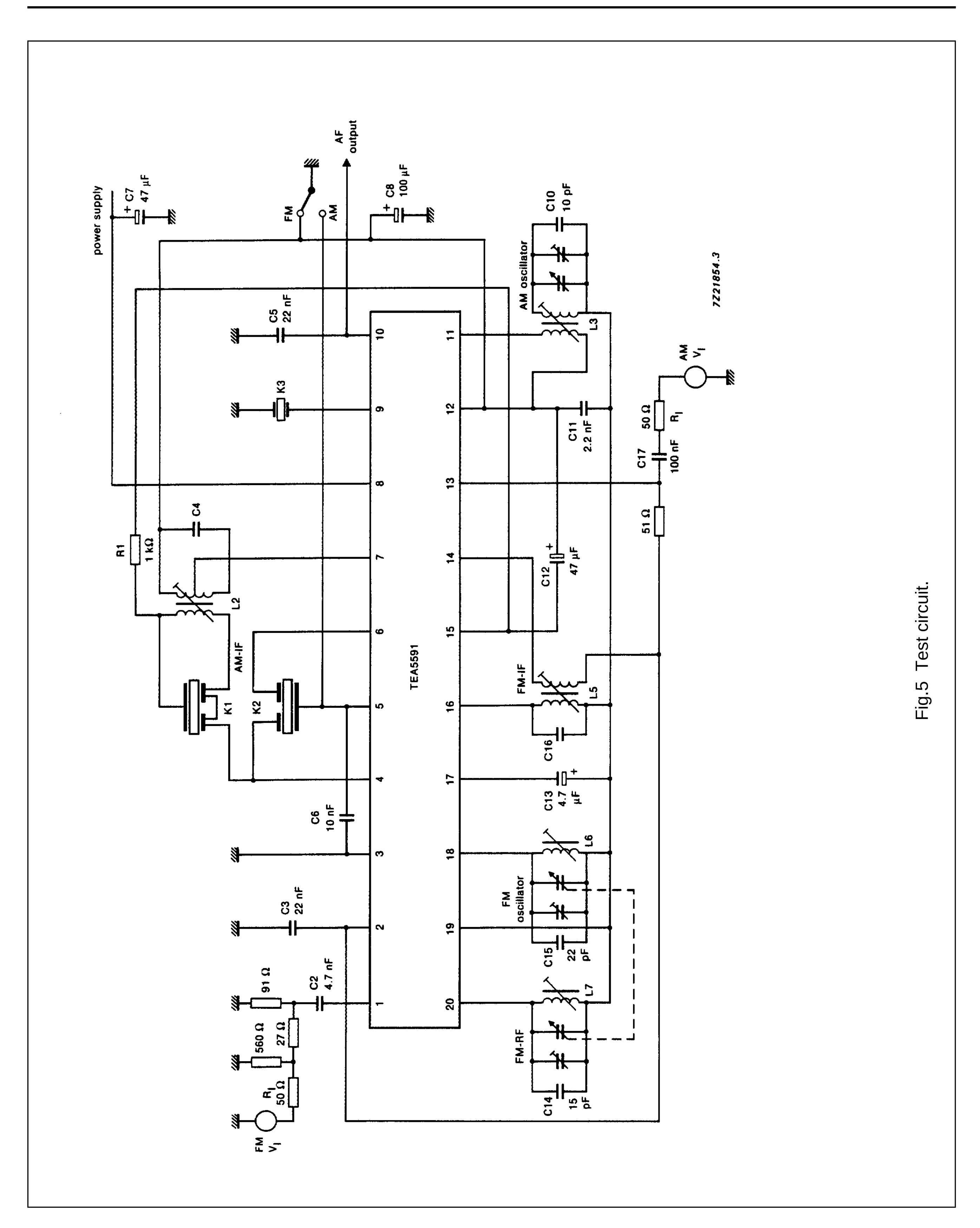


Fig.5 Test circuit.

APPLICATION INFORMATION

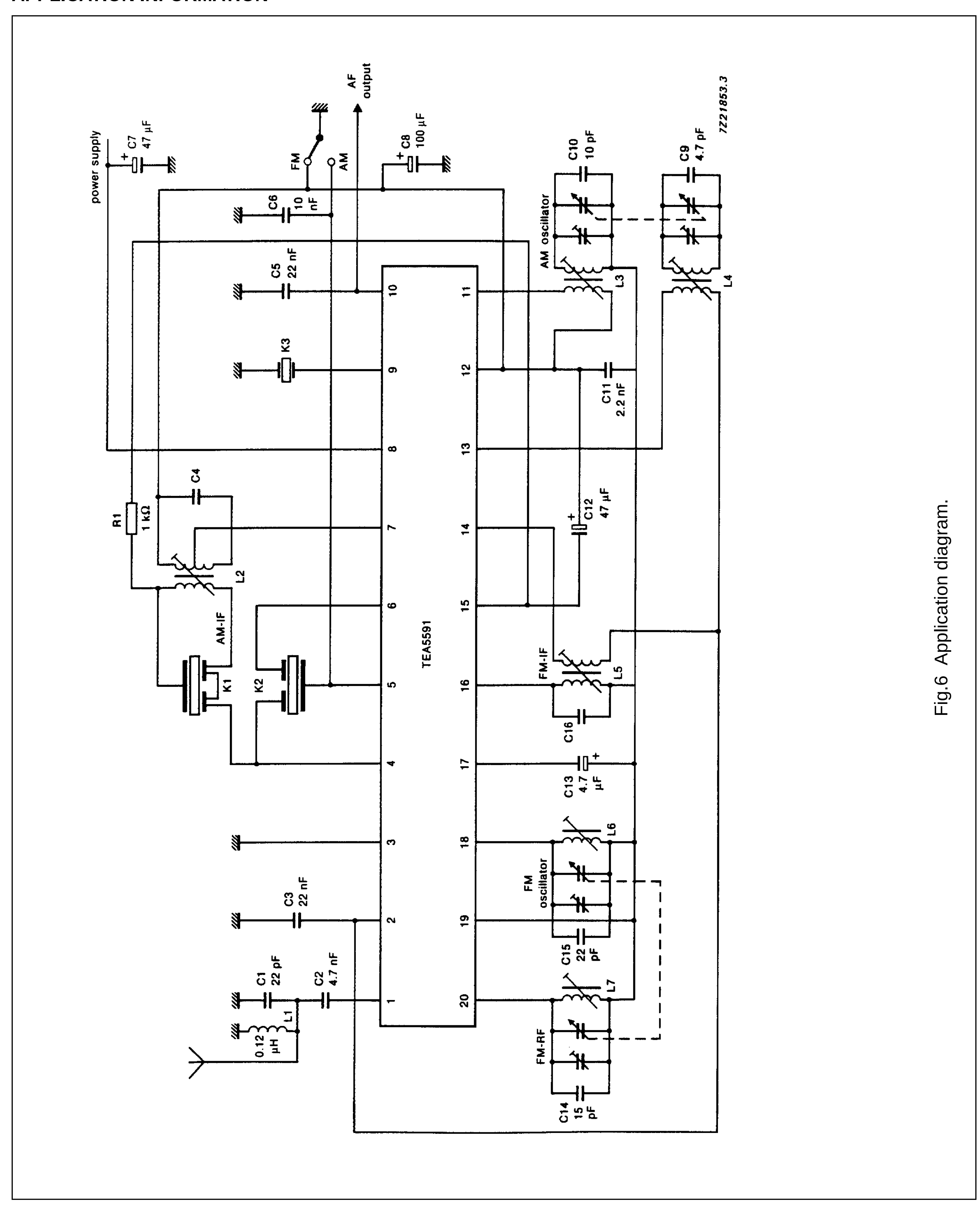


Fig.6 Application diagram.

Component data

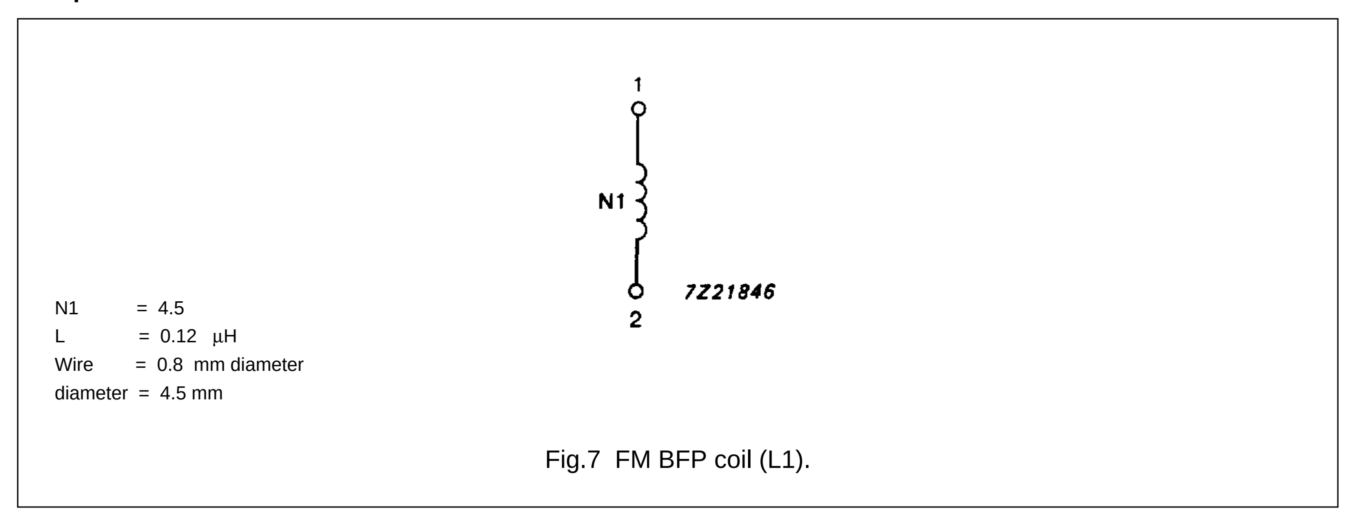


Fig.7 FM BFP coil (L1).

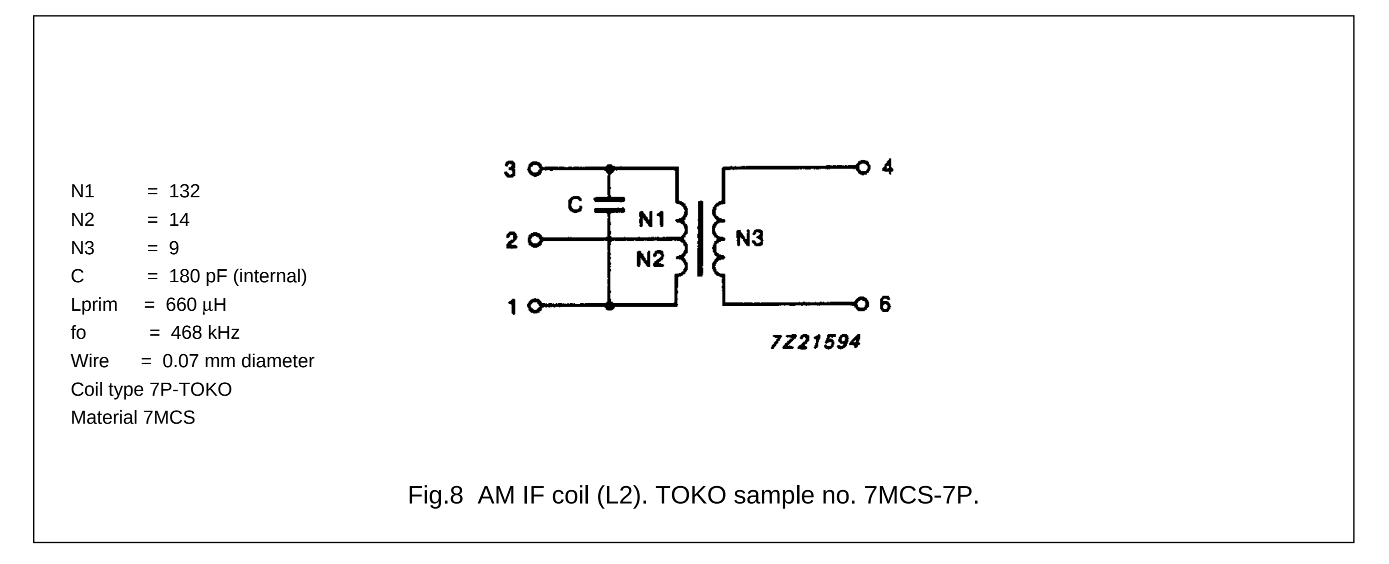


Fig.8 AM IF coil (L2). TOKO sample no. 7MCS-7P.

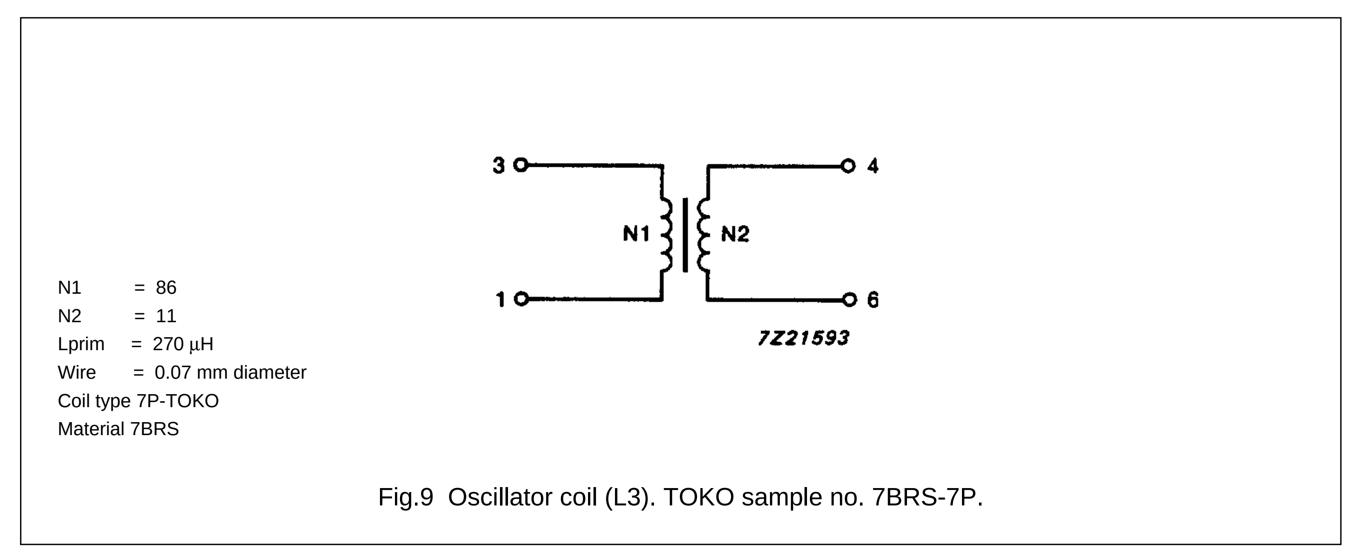


Fig.9 Oscillator coil (L3). TOKO sample no. 7BRS-7P.

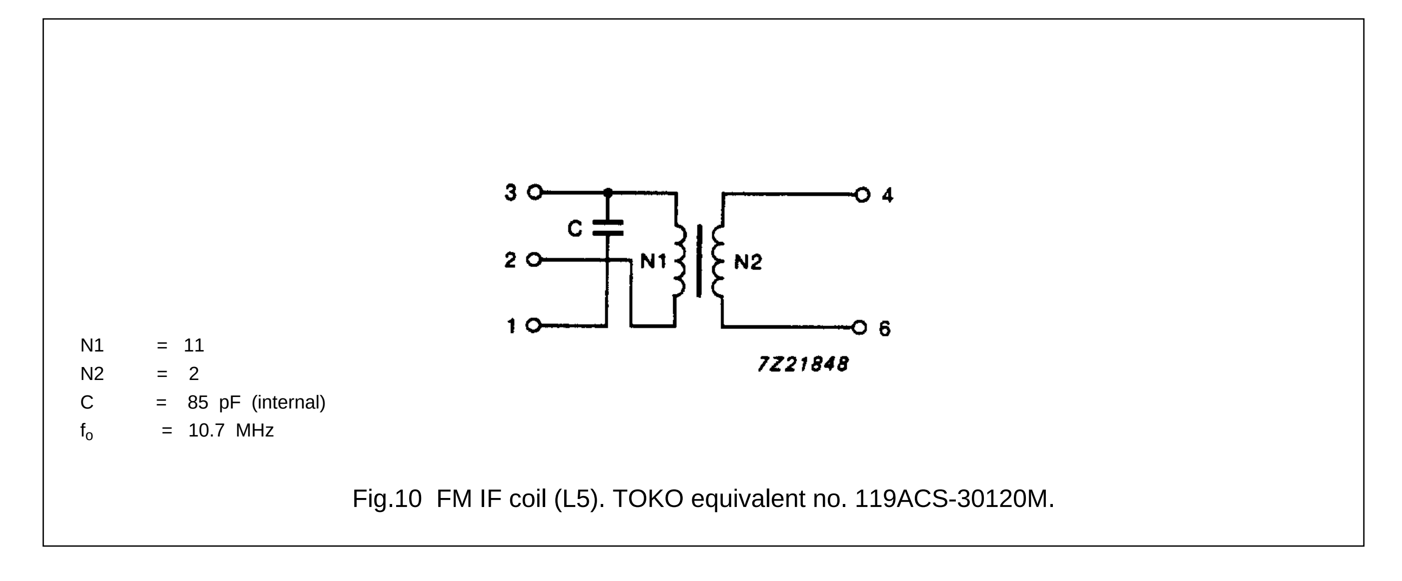


Fig.10 FM IF coil (L5). TOKO equivalent no. 119ACS-30120M.

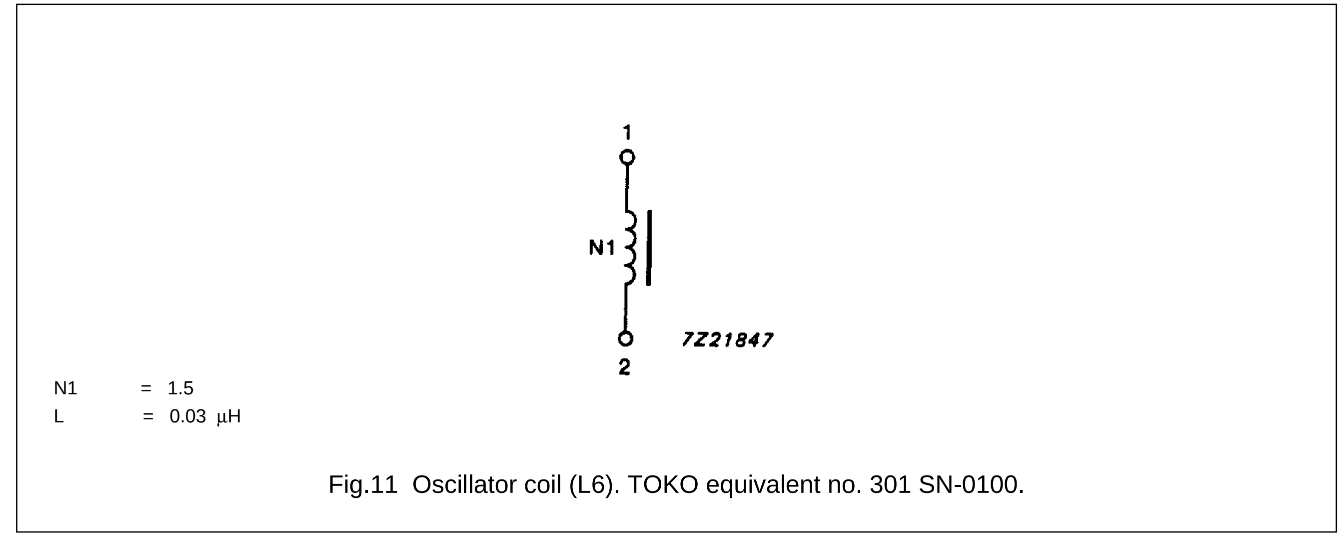


Fig.11 Oscillator coil (L6). TOKO equivalent no. 301 SN-0100.

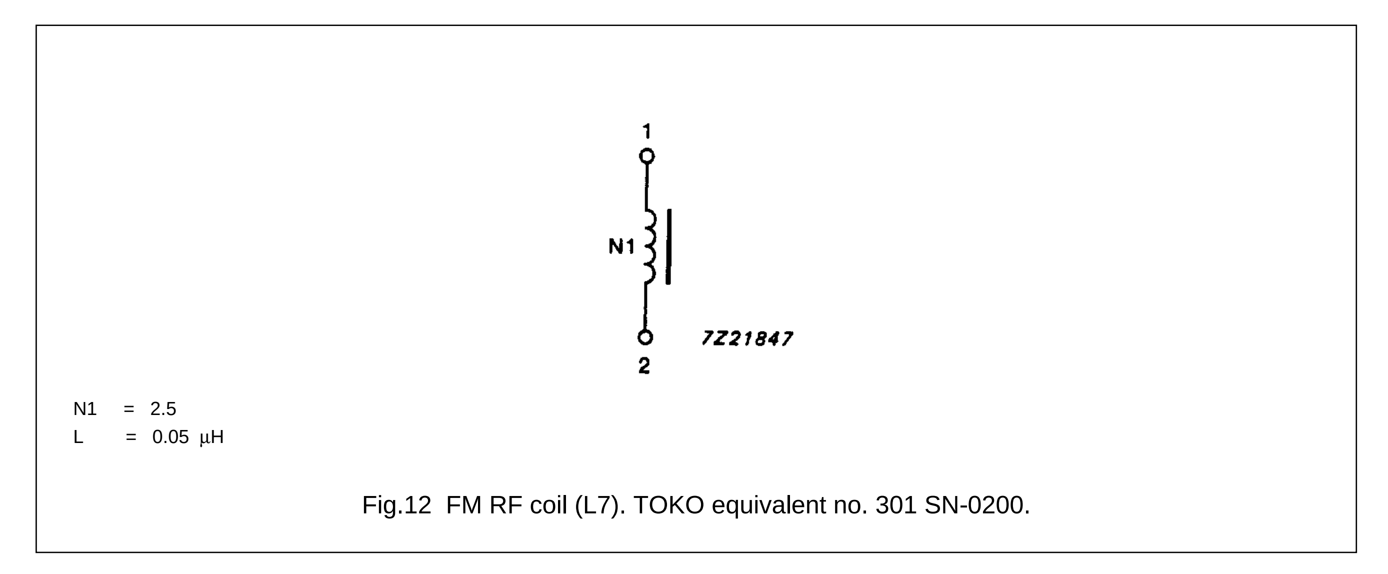


Fig.12 FM RF coil (L7). TOKO equivalent no. 301 SN-0200.

FERROCEPTOR COIL

L4: N1 = 105; N2 = 10; L = 625 μH

CERAMIC FILTERS

AM IF (K1). SFZ468 HL.

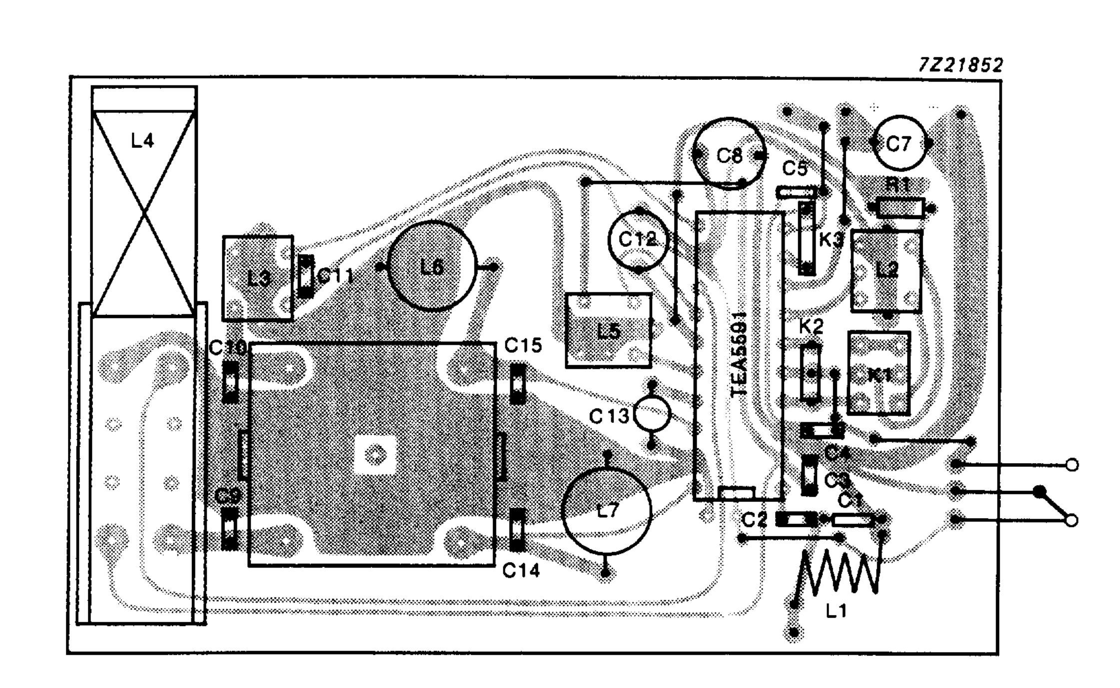
FM IF (K2). SFE10 . 7 MS2.

FM detector (K3). CDA10 . 7 MC1.

TUNING CAPACITORS

AM 140/82 pF

FM 2 × 20 pF



Physical dimensions of the printed circuit board = 5.0 × 8.1 cm.

Fig.13 Printed-circuit board component side, showing component layout. For circuit diagram see Fig.6.

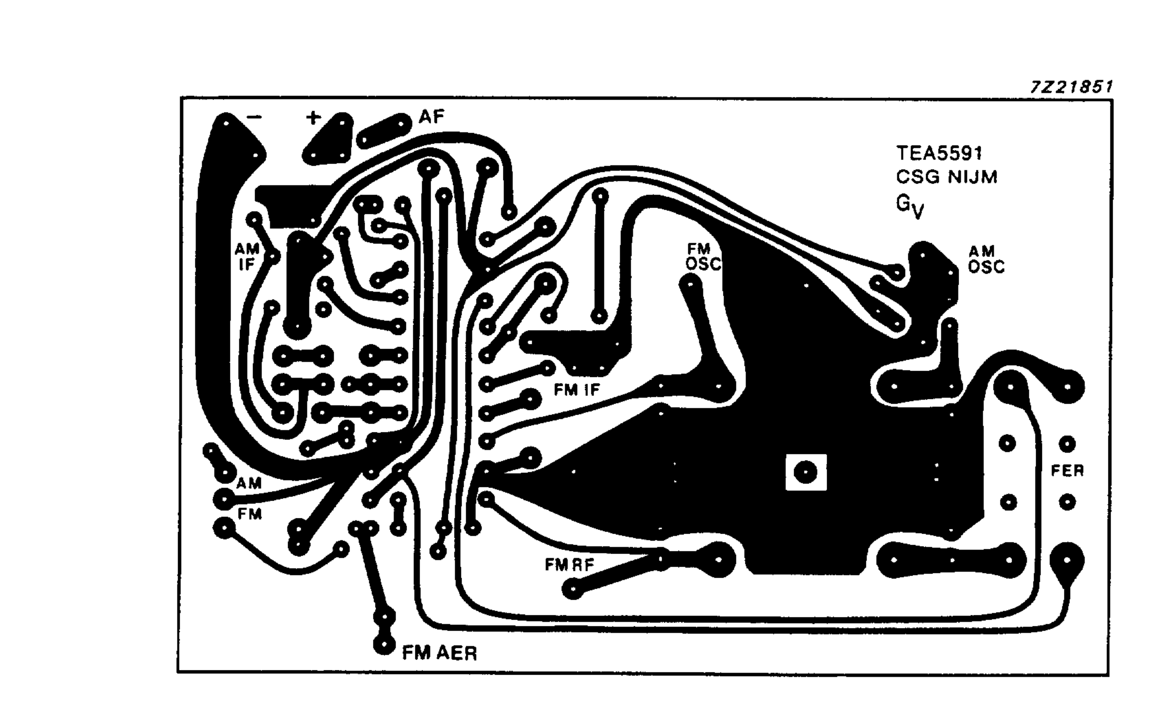


Fig.14 Printed-circuit board showing track side.

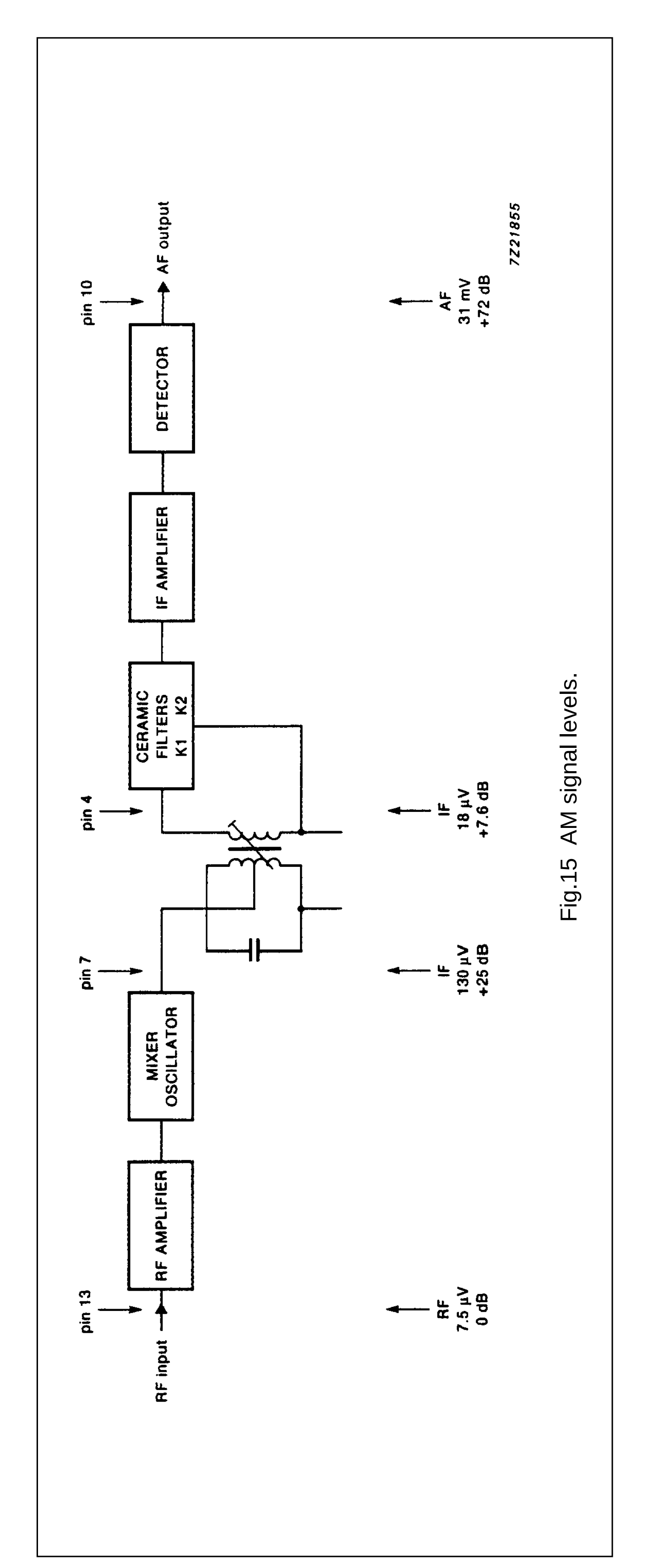


Fig.15 AM signal levels.

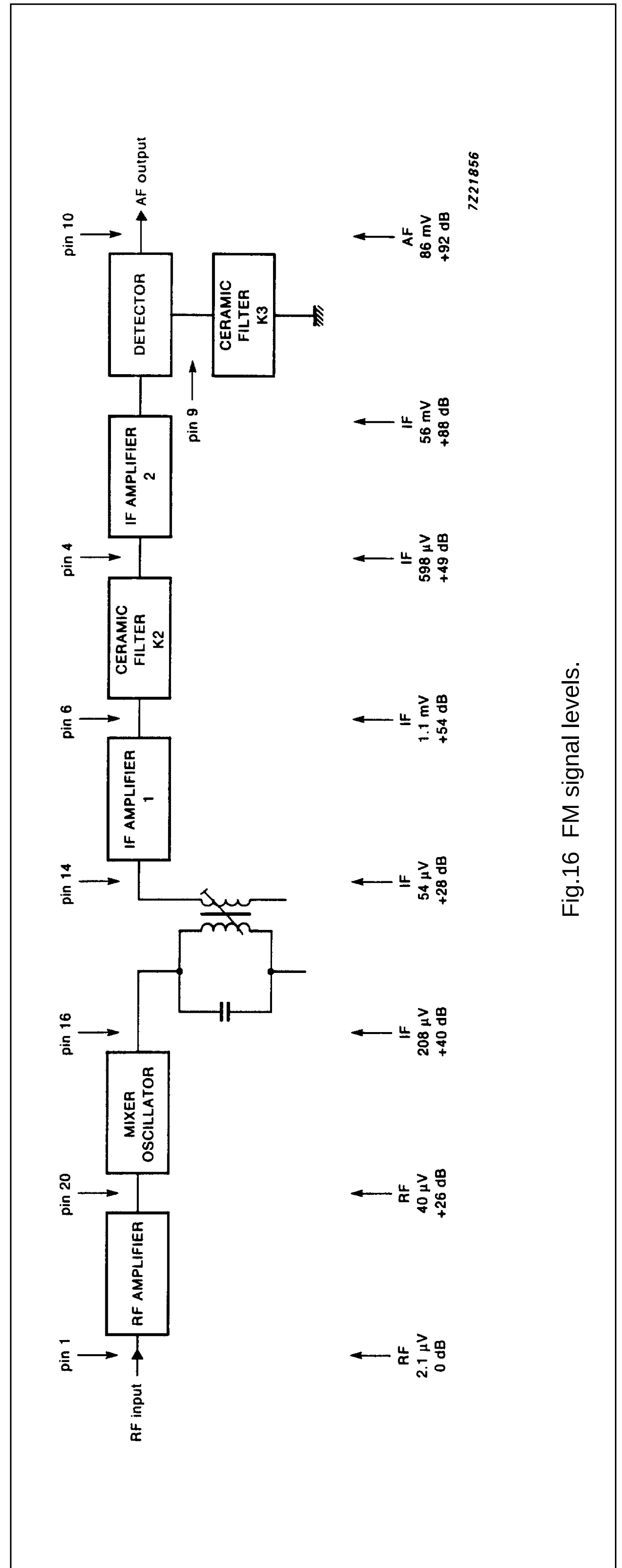


Fig.16 FM signal levels.

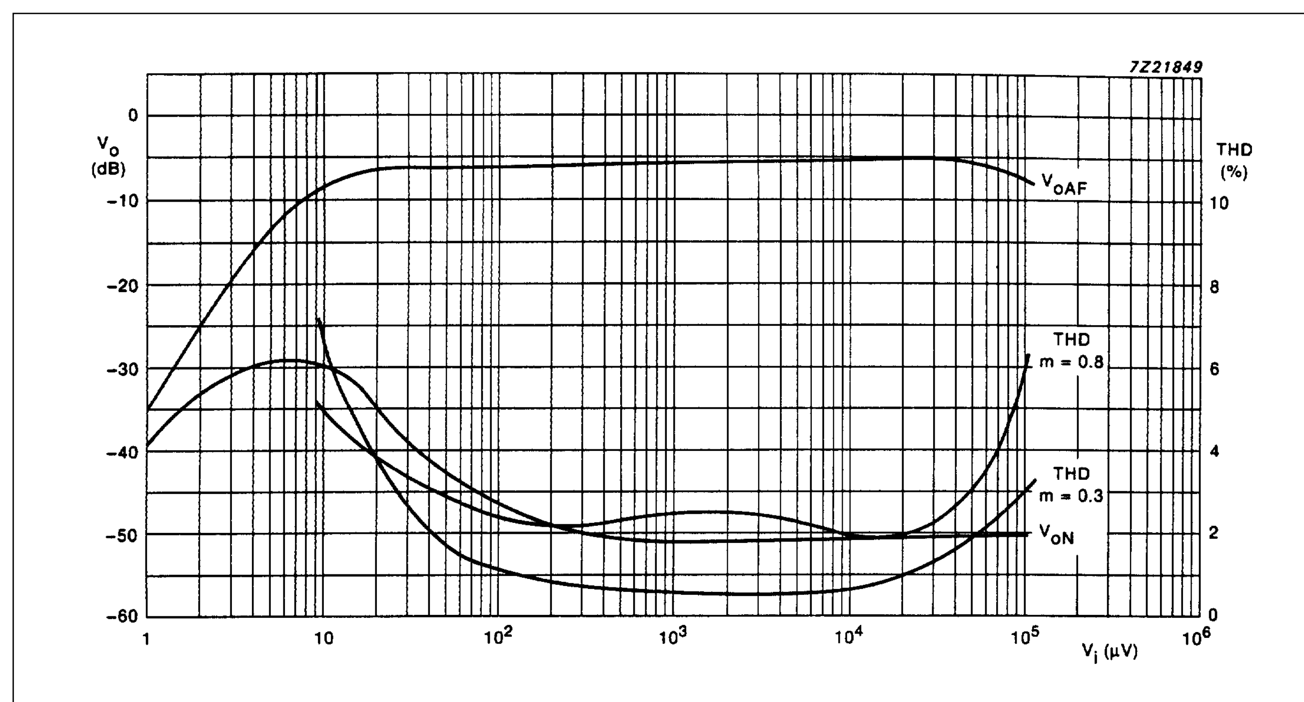


Fig.17 Signal and noise (V_{oAF}), noise (V_{oN}); reference level 0 dB = 100 mV, and total harmonic distortion (THD) as a function of input voltage (V_i) at pin 13. Measured in test circuit Fig.5. AM AGC is measured at f_i = MHz; f_{mod} = 1 kHz; m = 0.3. AM distortion is measured at f_i = 1 MHz; f_{mod} = 1 kHz.

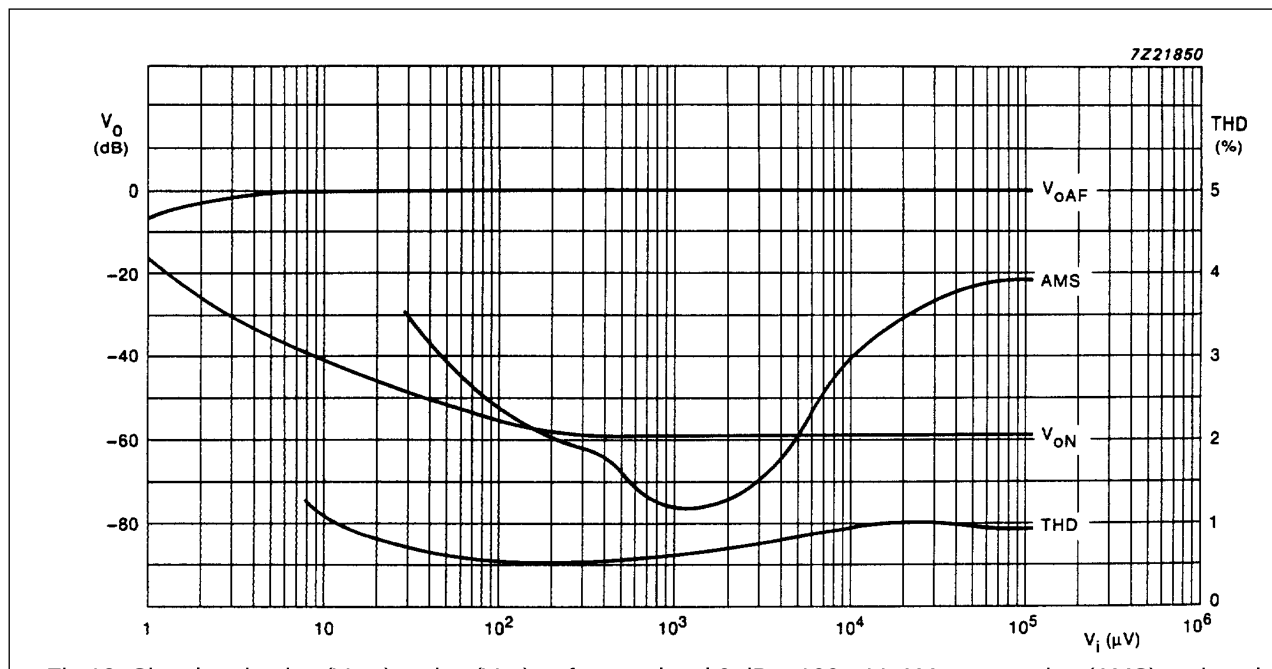
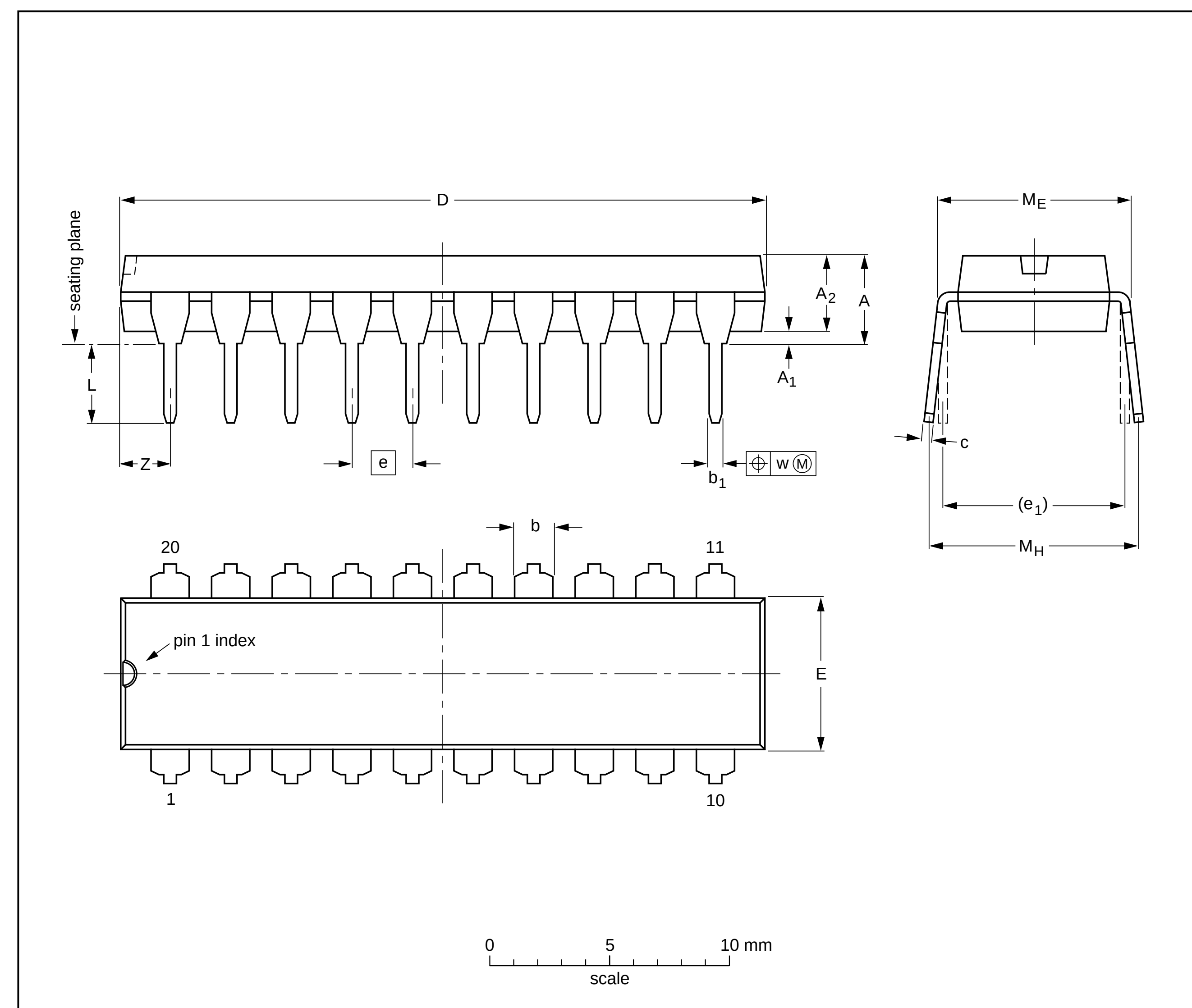


Fig.18 Signal and noise (V_{oAF}), noise (V_{oN}); reference level 0 dB = 100 mV; AM suppression (AMS) and total harmonic distortion (THD) as a function of input voltage (V) at pin 1. Measured in test circuit Fig.5 at f_i = 98 MHz; f_{mod} = 1 kHz; Δf 22.5 kHz. AM suppression is measured at f_{mod} = 400 Hz, m= 0.3 for AM; f_{mod} = 1 kHz, Δf = 75 kHz for FM.

PACKAGE OUTLINE

DIP20: plastic dual in-line package; 20 leads (300 mil) **SOT146-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT146-1			SC603			~~92-11-17~~ 95-05-24

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.